

State of Missouri

***Regulatory Impact Report
for Proposed Rule Amendment
10 CSR 80-2.010—Definitions,
and
10 CSR 80-2.015—Preliminary Site Investigation,
Detailed Site Investigation Workplan, Detailed Site
Investigation and Characterization Report***



Missouri Department of Natural Resources
Division of Geology and Land Survey
Geological Survey Program

February 8, 2006

Missouri Department of Natural Resources
Regulatory Impact Report
For
Proposed Amendment to 10 CSR 80-2.010 and 10 CSR 80-2.015

Division/Program: Division of Geology and Land Survey, Geological Survey Program

Rule Number: 10 CSR 80-2.010 **Rule title:** Definitions

Rule number: 10 CSR 80-2.015 **Rule title:** Preliminary Site Investigation, Detailed Site Investigation Work Plan, Detailed Site Investigation and Characterization Report

Type of rule action: Amendment to Existing Rule

Nature of the rulemaking: Prescribes environmental standards

Submitted by Joe Gillman

Program Director Date_____

Approval of the Completed Regulatory Impact Report

Legal Counsel Date_____

Division Director Date_____

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Regulatory Impact Report
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Applicability: Pursuant to Section 640.015 RSMo, “all rulemakings that prescribe environmental conditions or standards promulgated by the Department of Natural Resources...shall... be based on the regulatory impact report....” This requirement shall not apply to emergency rulemakings pursuant to section 536.025 or to rules of other applicable federal agencies adopted by the Department “without variance.”

The Missouri Department of Natural Resources has determined this rulemaking prescribes environmental conditions or standards and verifies that this rulemaking is not a simple unvarying adoption of rules from other federal agencies. Accordingly, the department has produced this regulatory impact report which will be made publicly available for comment for a period of at least 60 days. Upon completion of the comment period, official responses will be developed and made available on the agency web page prior to filing the proposed rulemaking with the Secretary of State. Contact information is at the end of this regulatory impact report.

1. Describe the environmental conditions or standards being prescribed.

This rulemaking would clarify state environmental standards for determining the geologic and hydrologic suitability of a proposed solid waste disposal area (landfill). Section 260.205 RSMo requires the department to approve or disapprove a proposed site prior to issuance of a construction permit. This rulemaking is an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area. In part, the proposed rule attempts to identify and define those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste disposal area. Several adverse geologic or hydrologic conditions have been identified in the proposed rule. These conditions are summarized and include:

- Groundwater that must be pumped in order to keep wastes within the proposed solid waste disposal area isolated above the water table;
- Permeable geologic media, including karst terrane, that may provide a pathway for the rapid migration of fluids from the site into the uppermost regional aquifer and/or the rapid migration of groundwater from the site to a surface water body;
- Permeable geologic media, including soil or bedrock with karst terrane features, faults, joints, fractures, or voids that provide a pathway for the migration of landfill-derived gases outside the site;
- A fault that has experienced movement during the Holocene epoch that is located within the boundaries of the proposed solid waste disposal area;
- Groundwater that cannot be effectively monitored on-site due to karst terrane conditions;

- The presence of subsurface voids or conditions that present a significant potential for collapse.

The rule also attempts to identify and define those geologic and hydrologic conditions which render a site unsuitable for development of a utility waste disposal area. As discussed in section 2 and **Appendix A** of this Report, by-products derived from the combustion of fossil fuels are comparatively inert. These materials can be placed in areas where the geologic or hydrologic conditions would not be suitable for development of a solid waste or demolition waste disposal area. These conditions are summarized and include:

- A fault that has experienced movement during the Holocene epoch that is located within the boundaries of the proposed solid waste disposal area;
- Groundwater that cannot be effectively monitored on-site due to karst terrane conditions;
- The presence of subsurface voids or conditions that present a significant potential for collapse.

Additionally, the rule defines solid waste disposal area siting criteria that would apply to sites proposed in areas of optimum geologic and hydrologic suitability. Several geologic or hydrologic conditions that may be well suited for the development of a solid waste disposal area have been identified in the proposed rule. These conditions are summarized and include:

- A facility underlain by a combined thickness of 50 feet of low-permeability geologic material that inhibits the movement of fluids into the uppermost regional aquifer that is currently used or is reasonably likely to be used as a future domestic drinking water source. This low permeability material must be comprised of shale, mudstone or glacial deposits comprised primarily of clay or silt size particles, and lack karst terrane features, continuous sand or gravel layers, faults, fractures, cracks, voids, or other features that provide a pathway for the rapid migration of fluids or gases off the site;
- A facility underlain by an aquifer(s) that are in geohydrologic connection with the proposed solid waste disposal area that do not yield potable groundwater or are not capable of producing greater than 360 gallons of water per day from a domestic well.

Proposed landfill sites that have criteria set forth in this portion of the rule would be subject to less site characterization requirements which could potentially lead to an expedited site characterization process. This would reduce the necessary timeframe required to receive a construction permit. Additionally, the less time an applicant has to spend on site characterization activities, the more cost effective it will be to develop a site. Sites with favorable geologic and hydrologic conditions will be developed more economically and faster than in the past.

The proposed rulemaking should clarify the conditions for site disapprovals and resolve inconsistencies so that all sites are evaluated and approved or disapproved on the basis of prescribed conditions set forth in the rules. It will also clarify which site

conditions are considered geologically and hydrologically favorable and set forth characterization guidelines that could potentially reduce the time and expense of developing a proposed site.

Several phrases and words in the proposed rule needed to be defined in order to clearly detail their meaning as it applies to the proposed rule. For consistency and ease of reference, these definitions have been added to **10 CSR 80-2.010**. The addition of these definitions do not in and of themselves constitute a change in the regulation, they increase the consistency in how the terms are used in implementing the rule.

2. A report on the peer-reviewed scientific data used to commence the rulemaking process.

Section 260.205 RSMo requires the department to approve or disapprove a proposed site prior to issuance of a construction permit. The Statute recognizes that there are locations in Missouri that are not suitable for the development of a solid waste disposal facility because of naturally existing conditions. This Section established the two-phase site investigation process for the purpose of screening out proposed sites on the basis of geologic and hydrologic characteristics prior to the applicant considerable effort to investigate and develop a proposed site.

This rulemaking is an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area. Therefore, providing clarity and understanding to the meaning of “geologic and hydrologic characteristics,” through the establishment of conditions which render a site unsuitable for development of a solid waste disposal area. In addition, some of the rule language was guided in response to public input. In 2005, the department held six (6) stakeholder meetings to receive public input regarding potential changes to the solid waste rules. Stakeholders involved in the process included individuals from community associations, environmental and engineering consultants, academia, industrial groups, local government, legal firms, landfill operators, environmental organizations, the public, elected officials, and state agencies. A list of the information used to develop the rule, including technical documents and data, is included as **Appendix A**.

Solid waste disposal

Landfilling is a cost-effective method of disposing of solid waste. Developed in sound geologic environments, landfills can provide safe, long-term disposal options for municipal and other waste streams. Unfortunately, landfills can have adverse environmental effects. Over 25% of the superfund sites listed on the National Priorities List (NPL) are landfills, three of these are located in Missouri. Toxic substances can be released into the environment from landfills via leachate and airborne emissions of gases.

Landfill design is based on the premise that artificial or composite lining systems can contain all leachate produced during degradation of the landfill waste, and provide protection to groundwater. The effectiveness of such a containment system is

dependent on the design and engineering of each site, quality control during installation of the liner system, maintenance and care during waste disposal operations, and high levels of maintenance throughout the operation life of the landfill. This represents a purely engineered solution to leachate containment.

The long-term durability of liners is unproven. Artificial and composite landfill liners have only been in use for about 30 years, so their long-term performance is uncertain. Some studies have shown particular deficiencies associated with artificial lining systems. These deficiencies include: degradation from long-term contact with corrosive leachate, stress cracking, cold cracking, embrittlement due to exposure, damage from poor dumping practices, and failure near welded seams. Engineering uncertainties as to the long-term durability of synthetic lining systems, increases the potential for liner failure at some stage in the future while leachate is still being produced leading to groundwater pollution.

Development of geologic and hydrologic siting criteria

One of the state's most important and valuable resources is high quality groundwater. This groundwater is contained in and migrates through bedrock or unconsolidated aquifers. In some areas of the state there are multiple aquifers present with vast quantities of high quality groundwater, however, in areas where groundwater resources are poor there may be only one usable aquifer or simply none at all. Protection of the state's groundwater resources is an important factor in public safety and overall economic health of our state. Missourians often can safely rely on groundwater with minimal or no treatment saving considerable economic resources each year. The uses of this water include domestic consumption, industrial usage, power generation, irrigation, and recreation. Large supplies of high quality groundwater are vital to the overall public health and safety and important for economic vitality of the state.

The department estimates that approximately 1.6 million Missouri citizens get their domestic water supply from groundwater resources. Thirty percent (30%) of the state's population relies on clean, potable groundwater for daily use and consumption. This fact alone demonstrates the importance Missourians place on clean water. Table 1 outlines further analysis of statewide water usage and the importance of groundwater in many sectors of the state's economy and attempts to affix a monetary value on this resource. Data from the United States Geological Survey, the National Groundwater Association, and the department's Water Resources Center was used to calculate total groundwater consumption in Missouri and the economic value of this groundwater as a resource.

Table 1. Missouri Groundwater Usage and Estimated Economic Value

Water Use	Usage in gallons per year (2000 data)	Economic value in dollars (2004 data)
Drinking Water Supply	124.5 billion	\$300,000,000
Industrial/ Mining	12 billion	\$657,000
Power Generation	4.1 billion	\$224,000
Irrigation	502.8 billion	\$27,000,000
Agriculture	7.4 billion	\$405,000
Totals	650.8 billion	\$328,286,000

It is anticipated that the demand for clean, usable groundwater will only increase. Protection of these resources means a future supply of groundwater for domestic usage, commerce, industrial needs, power generation, and other components that are crucial to support a society. A shortage of clean, potable groundwater could severely impact many human activities including commercial development, industrial development, agriculture, tourism, and overall health of the population.

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area. Specifically, the proposed language identifies and defines those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste or demolition waste disposal area. Several geologic and/or hydrologic conditions have been identified which are considered to be unsuitable for development of a landfill. Development of solid waste sites in these geologic and hydrologic settings could pose a significant risk of groundwater contamination should engineering controls fail to contain landfill leachate or gas. These environmental settings are not considered to provide natural protection or containment of landfill pollutants in the event of a catastrophic or chronic failure of the landfill. These conditions also would not allow for detection of such failures prior to human health and safety or environmental impacts. Proposed sites known to have the following conditions would be denied by the department:

1. Sites that have hydrologic characteristics that require groundwater be pumped in order to keep wastes within the proposed solid waste disposal area isolated above the water table. This type of development relies solely on engineering controls to keep

groundwater separated from the landfill. These sites rely on infinite pumping to keep groundwater “drawn down” or depressed below the level of the landfill bottom and thus separated from contact with the landfill liner. Should engineering controls fail, the landfill liner would be in direct contact with groundwater. In the event of a failed landfill liner, the waste material would potentially become saturated. Leachate would contaminate groundwater, and groundwater movement would no longer be controlled by on-site pumping. Site selection process should take into account geologic factors including separation for the seasonal high water table and hydrologic isolation of waste.

2. Sites that are underlain by permeable geologic media, including karst terrane, that may provide a pathway for the rapid migration of fluids from the site into the uppermost regional aquifer and/or the rapid migration of groundwater from the site to a surface water body. Karst aquifers are inherently anisotropic and heterogeneous. They typically have three different types of porosity including: primary, intergranular porosity; fracture porosity; and dissolution porosity. The dissolution porosity forms the conduit flow regimes in these aquifers. Groundwater flow networks in karst aquifers can transport large quantities of water very rapidly. Monitoring of groundwater in these geologic settings is inherently difficult due to the variability of the geology and hydrologic flow regimes. Due to the anisotropic and heterogeneous characteristics of karst aquifers, contaminants released into these aquifers could potentially go undetected by a groundwater monitoring network and impact water supplies. Additionally, in these geologic and hydrologic settings there is no natural underlying geologic barrier to control leachate migration in order to provide secondary protection to groundwater in the event of liner failure or leakage. The need for a natural geologic barrier to leachate migration is regarded as necessary to provide containment, in the event of failed engineering of the landfill liner, and reduce the potential risk of groundwater contamination. A natural barrier above the aquifer will allow for secondary protection to groundwater prior to water supply impacts.
3. Permeable geologic media, including soil or bedrock with karst terrane features, faults, joints, fractures, or voids that provide a pathway for the migration of landfill-derived gases outside the site. Landfill gas is produced during the long-term degradation of the organic portion of solid waste. The gas produced typically consists of methane, carbon dioxide, and sulphur dioxide. In the event of failed engineering of the landfill liner or gas control measures, gas will migrate vertically or laterally beyond the landfill boundaries in the surrounding geologic formations and in some cases released to the atmosphere. In karst geologic settings and settings where fluid or gas flow is primarily from fracture porosity and dissolution porosity, detection and control of the gases could be difficult or impossible to achieve. This gas could migrate rapidly in an unpredictable fashion. If released to the atmosphere, this gas provides a threat to the environment and public health and safety. Methane can be explosive in air at concentrations as low as 5%-15%. It can also replace oxygen in breathing spaces causing severe health impacts or death through asphyxiation.
4. Sites that are underlain by a fault that has experienced movement during the Holocene epoch that is located within the boundaries of the proposed solid waste disposal area. The Code of Federal Regulations found in 40 CFR 258 establishes location restrictions for the siting of municipal solid waste landfills. One of these restrictions prohibits landfills from being located within 200 feet of a fault that has had displacement in Holocene time unless the developer demonstrates that an

alternative setback distance is appropriate. This portion of the rulemaking was developed using the Federal guidance. Ground displacement due to an active fault could seriously jeopardize the integrity of the low permeability clay liner and partially or totally inhibit the ability of the liner and leachate collection system to operate as designed. The landfill liner and cap would be compromised if fault movement occurred during the operation of the landfill or post-closure.

5. A site where groundwater cannot be effectively monitored on-site due to karst terrane conditions. As previously discussed, groundwater flow networks in karst aquifers can transport large quantities of water very rapidly. Monitoring of groundwater in these geologic settings is inherently difficult due to the variability of the geology and hydrologic flow regimes. Due to the anisotropic and heterogeneous characteristics of karst aquifers, contaminants released into these aquifers could potentially go undetected by a groundwater monitoring network.
6. The presence of subsurface voids or conditions that present a significant potential for collapse. Environmental and engineering problems in carbonate terrane are largely the result of dissolution of limestone, dolomite, or other soluble bedrock. Karst terrane and sinkhole prone areas present special problems and challenges for the design and construction of a landfill because of the variable, unpredictable and changeable nature of the soil and rock that may support the structure. Gradual subsidence or catastrophic collapses beneath landfill sites could destroy the integrity of the low permeability clay liner and partially or totally inhibit the ability of the liner and leachate collection system to operate as designed.

The preliminary site investigation process involves a regional approach to site hydrogeology and groundwater protection. Sites that are proposed for development in karst terranes, that may be subject to catastrophic collapse, and those which provide no suitable natural geologic or hydrologic barrier to regional groundwater contamination should be avoided and therefore will not progress to the detailed site investigation process. The unfavorable geologic conditions must be known to exist at the proposed site to be denied at this stage. All of these potential problems are concerns in certain areas of Missouri.

Utility waste landfills

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed utility waste disposal area. Specifically, the proposed language identifies and defines those geologic and hydrologic conditions which render a site unsuitable for development of a utility waste disposal area. Proposed sites with these conditions would be denied by the department.

By-products derived from the combustion of fossil fuels are relatively inert when compared to putrescent or demolition waste. The current rules allow for reuse of some of this material with limited environmental controls. Therefore, the characteristics of this material allow for placement in areas where the geologic or hydrologic conditions would not be suitable for development of a solid waste or demolition waste disposal area. The proposed rule should not negatively impact the future development and construction of power generation facilities or utility waste disposal sites. The geologic or hydrologic conditions outlined in the rule only

prohibit development in areas where there is significant risk for catastrophic collapse or an inability to effectively monitor landfill liner performance through an effective groundwater monitoring network. It is anticipated the proposed rulemaking will be to reduce or eliminate the potential risks from utility waste disposal facilities in areas where specific geologic or hydrologic conditions are poor. Thereby providing protection for groundwater resources and the public health and safety.

Combustion by-products include flyash, bottom ash, and boiler slag. These materials are produced when fossil fuels are burned to provide power generation and consist of primarily of silica, aluminum, iron oxides, and calcium. These materials also can contain a wide range of heavy metals associated with fossil fuels including boron, lead, cadmium, chromium, zinc, arsenic, mercury, selenium, tin, barium, copper, manganese, uranium, magnesium and vanadium. However, not all of elements are present in all combustion by-products. The presence and concentration of these materials is variable and can depend on the type of coal (or other fuel) burned and the location in which the coal was mined. By nature, by-products from fossil fuel combustion do not produce organic leachates that are common in municipal waste landfills. Organic materials found in the fuels are consumed during the combustion process (the reason for use as a fuel) and are not found in the residual by products. Combustion by-products typically have low solubility. It is reported that most of the metals present in the ash are firmly within or adhered to the aluminum-silicates which results in a very low leaching potential. Research on combustion by-products demonstrates that leachate testing of this material produces very low concentrations of metals. Additionally, since combustion by-products do not contain organic material, there is nothing that will undergo organic degradation. Therefore, when landfilled, these by-products do not produce gas.

The EPA has concluded that the beneficial uses of fossil fuel combustion wastes pose no significant risk and additional regulations beyond what is required by RCRA Subtitle D requirements are not needed. In addition, the EPA has determined that beneficial use of these wastes conserve natural resources, reduce disposal costs and reduce the amount of waste placed in landfills. These by- products rapidly accumulate and require disposal or other management strategies. Currently, combustion by-products are managed in several ways. Some wastes are managed in traditional methods by disposal in utility waste landfills. Other wastes are utilized as raw material for use in replacing cement in concrete products such as bricks, block, and pavers. Additionally, some of the waste stream is utilized in a beneficial use application. Per the guidelines set forth in **10 CSR 80-2.020(9)**, there are potential options for the reuse of this material in a beneficial application. The use of fly ash for concrete or flowable fill additive and the beneficial use of bottom ash or boiler slag for snow and ice control is allowed without the issuance of a permit provided that pollution, a public nuisance or a health hazard is not created. The department may also grant an exemption from having to obtain a solid waste disposal permit for a proposal to beneficially reuse solid waste, provided that the beneficial use can be demonstrated and provided that pollution, a public nuisance or a health hazard will not be created. The solid waste management rules allow for use of certain materials if they meet specific physical and chemical properties. When managed properly and in compliance with applicable federal and state laws, the department has determined that

coal combustion by-products have appropriate beneficial uses as structural fill, road base construction, and soil stabilization. Combustion by-products have been used as fill material for construction applications, fill for road beds and rail beds, as blasting grit, for roofing material, and fill for mine reclamation purposes. Minefill reclamation includes placing ash in surface pits and underground emplacement in mine voids. The department has issued statewide beneficial use exemptions for specific applications of this material.

In accordance with the rules, the department may also grant a general exemption for the beneficial use of type C fly ash and associated bottom ash and boiler slag for beneficial use as road base or structural fill, as a soil amendment or for soil stabilization, and as daily cover in a landfill.

Analytical data from ash collected at several coal-fired power plants operated by Associated Electric Cooperative Inc., Aquila, Kansas City Power and Light, and Springfield City Utilities was reviewed. This included data from 1991 through 2005 and represented ash derived from several different coal sources. The analysis of the raw data from leaching tests demonstrates that many metal analytes fall below detection limits and do not exceed applicable regulatory levels.

Sites well suited for the development of a landfill

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area. Specifically, the proposed language identifies and defines those geologic and hydrologic conditions which may be well suited for the development of a solid waste disposal area. Several geologic and/or hydrologic conditions have been identified which are considered to be optimum for development of a landfill. Development of solid waste sites in these geologic and hydrologic settings is considered to not pose a significant risk of groundwater contamination should engineering controls fail to contain landfill leachate or gas. These environmental settings are considered to provide natural protection or containment of landfill pollutants in the event of a catastrophic or chronic failure of the landfill or are in hydrologic settings that are not in connection with a regional aquifer. These conditions are further discussed below.

1. A facility underlain by a combined thickness of 50 feet of low-permeability geologic material that inhibits the movement of fluids into the uppermost regional aquifer that is currently used or is reasonably likely to be used as a future domestic drinking water source. This low permeability material must be comprised of shale, mudstone or glacial deposits comprised primarily of clay or silt size particles, and lack karst terrane features, continuous sand or gravel layers, faults, fractures, cracks, voids, or other features that provide a pathway for the rapid migration of fluids or gases off the site. The presence of a thick, unfractured sequence of these materials will significantly inhibit the vertical migration of surface water. Various rock types with representative values of hydraulic conductivity in the 10^{-6} range and lower can include dolomitic limestone, siltstone, shale, salt, and some unfractured igneous and metamorphic rocks. Sediments comprised of silty loess, till, and clay can also exhibit hydraulic conductivity values in the 10^{-6} range or lower.

2. A facility underlain by an aquifer(s) that are in geohydrologic connection with the proposed solid waste disposal area that do not yield potable groundwater or are not capable of producing greater than 360 gallons of water per day from a domestic well. This portion of the rule is intended to describe and protect those areas that are current or reasonably likely to be used as future domestic groundwater resources. The Missouri Risk Based Corrective Action process for underground storage tanks guidance document was utilized to establish this standard. The standard describes the suitability for use of groundwater as a domestic source as containing less than 10,000 mg/L total dissolved solids and aquifers capable of producing a minimum of ¼ gallon per minute, or 360 gallons per day, of sustained yield. The MRBCA guidance is based on the production of a 6-inch well that penetrates a prescribed portion of the saturated thickness of the aquifer.

Proposed landfill sites that have criteria set forth in this portion of the rule would be subject to less site characterization requirements which could potentially lead to an expedited site characterization process. This would reduce the necessary timeframe required to receive a construction permit. Additionally, the less time an applicant has to spend on site characterization activities, the more cost effective it will be to develop a site. Sites with favorable geologic and hydrologic conditions will be developed more economically and faster than in the past.

The proposed rulemaking should clarify the conditions for site disapprovals and resolve inconsistencies so that all sites are evaluated and approved or disapproved on the basis of prescribed conditions set forth in the rules. It will also clarify which site conditions are considered geologically and hydrologically favorable and set forth characterization guidelines that could potentially reduce the time and expense of developing a proposed site.

3. **A description of the persons who will most likely be affected by the proposed rule, including persons that will bear the costs of the proposed rule and persons that will benefit from the proposed rule.**

It is possible that in areas where adverse geologic or hydrologic conditions prohibit the development of a waste disposal site, the cost of disposal of solid waste to the individual citizen could be greater than in areas where a solid waste disposal site is located in close proximity. This could potentially cause a slight increase in disposal costs for the local citizens and communities where it will be required to transport solid waste to a permitted facility located within a suitable geologic setting. However, because the rule only clarifies existing practices for site evaluation, the rule should not change current costs significantly.

Long-distance transportation of solid waste is currently a relatively common practice within the industry under the current rule. For example, the City of Rolla, Missouri, currently sends its municipal refuse to a local transfer station operated on contract by Waste Corporation of America. Waste Corporation then transports this refuse to its own permitted solid waste disposal facility located in Hartville, Missouri, a distance of approximately 90 miles. Even though there are at least three other permitted solid waste disposal facilities located closer than the facility in Hartville (Prairie Valley,

Timber Ridge, Jefferson City), Waste Corporation opts to transport solid waste approximately 67-miles further than the closest permitted facility. Therefore, it is unlikely that the proposed rulemaking will have any significant impact on the distances required to transport waste and any potential increased costs associated with transportation are expected to be minimal.

The public will benefit from the new environmental standards for proposed solid waste disposal areas. The new rule will provide clarity on which type of natural conditions make a proposed landfill site suitable or unsuitable. When the natural conditions are known to be ideal, the site will move to the design phase more quickly. The benefit will be to avoid a scenario that could potentially lead to a local or regional water source being degraded by contaminants from a landfill. These costs associated with this scenario could include requiring water treatment systems on individual domestic wells, the providing a potable water supply to affected citizens, or the potential cost of new wells should a current aquifer or water source for a municipality be impacted. Protection of the state's groundwater resources is crucial. Clean, usable groundwater means an adequate supply for domestic usage, commerce, industrial needs, power generation, and other components that are essential to support a society. A shortage of clean, potable groundwater could severely impact many human activities including commercial development, industrial development, tourism, and overall health of the population. Development of site suitability conditions will lead to solid waste disposal facilities being sited in areas that are more suited for protection of the public and the environment.

The solid waste disposal industry and other developers of solid waste disposal facilities would benefit in several ways. A site developer would not have to spend large amounts of time and resources attempting to investigate and develop a site where known site characteristics would be deemed unsuitable based on the geologic or hydrologic conditions. Site developers and industry professionals will have a clear understanding of the geologic or hydrologic conditions that would render a site unsuitable prior to initiating characterization and investigation activities at a site. The proposed rulemaking will clarify the conditions for site disapprovals and resolve inconsistencies so that all sites are evaluated and approved or disapproved on the basis of prescribed conditions set forth in the rules.

It will also clarify which natural site conditions are considered geologically and hydrologically favorable and set forth characterization guidelines for sites located in those areas. This would potentially save a site developer money, time, and resources investigating and developing a site that has favorable geologic and hydrologic conditions. Additionally, sites that are developed in areas that are naturally protective of the environment and the public health could potentially reduce the long-term liability of the site for the developer. In the event of a contaminant release from a disposal facility, sites that are developed in favorable geologic environments would naturally have less of an impact on the environment and human health and safety. This would reduce the liability for a potential groundwater remediation program or natural resource damage restitution by the landfill owner.

4. A description of the environmental and economic costs and benefits of the proposed rule.

This section of the Report attempts to quantify the costs and benefits of the likely effects described in section 3. The proposed rulemaking will only apply to the development of new facilities or a new expansion of an existing facility. The proposed rulemaking is not intended to address those facilities that have previously received site approval and/or a operating permit from the department. Therefore, existing solid waste disposal facilities will not spend money or resources complying with this rulemaking. The proposed rulemaking does not implement new environmental standards on existing facilities, it would only apply to solid waste disposal facilities proposed after the rule becomes effective.

It is assumed that costs associated with siting and development of a landfill are eventually passed on to the consumer in the form of disposal fees. Whether or not these fees would be greater or lesser and by what amount would be determined by the owner of the disposal facility and cannot be reasonably estimated in the Report.

Offsetting the cost of the rule is the estimated costs associated with the potential of a local or regional water source becoming impacted by contaminants from a landfill that is located in an area with unfavorable geologic or hydrologic conditions. The costs associated with this scenario could include requiring water treatment systems on individual domestic wells, providing a potable water supply to affected citizens, or the potential cost of new wells should a current aquifer or water source for a municipality be impacted. In addition, there would likely be significant costs directed at environmental remediation and restoration and potential civil penalties enforced by the department. The degree of these potential impact is unknown in terms of cost simply because the effects from inaction are essentially incalculable. It is very difficult to make a determination of environmental costs and benefits without comparing the associated risk to public health and long-term environmental damage.

Failure to act would not effect the rule as it currently exists. Section 260.205 RSMo requires the department to approve or disapprove a proposed site prior to issuance of a construction permit. However, the current rule does not clearly identify and define those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste disposal area. Agency professionals use professional experience, discretion and scientific data and information to make a determination on the suitability of a proposed solid waste disposal area. The agency does this without clearly defined parameters outlined in the rule. This can lead to a perception that the agency is inconsistent when evaluating proposed landfills and the perception that each proposed site is not considered on the same merits. This type of environment has in the past, and would likely again, result in litigation against the agency from a concerned party whom did not agree with the department's decision to approve or disapprove a site. Litigation typically consumes an enormous amount of staff hours involving file research, interrogatories, depositions, administrative proceedings, and testimony.

Protection of the state's groundwater resources is an important factor in public safety and the state's overall economic health. The department estimates that groundwater usage by Major Water Users (defined as a person, firm or corporation having a water source and a pump capable of producing 100,000 gallons of water or more per day) for calendar year 2000 was 300 billion gallons. The uses of this water include domestic consumption, industrial usage, power generation, irrigation, and recreation. Large supplies of high quality groundwater are vital to the economic and environmental vitality of the state and means less risk to public health and safety. It is anticipated that the demand for clean, usable groundwater will only increase. Protection of these resources means a future supply of groundwater for domestic usage, commerce, industrial needs, power generation, and other components that are crucial to support a society. A shortage of clean, potable groundwater could severely impact many human activities including commercial development, industrial development, agriculture, tourism, and overall health of the population.

Development of site suitability conditions will lead to solid waste disposal facilities being sited in areas that provide a degree of natural protection to the public and the environment. In the event of a contaminant release from a disposal facility, sites that are developed in favorable geologic environments would pose less of a risk to environmental contamination and public health and safety.

The solid waste disposal industry and other developers of solid waste disposal facilities would benefit in several ways. A site developer would not have to spend money and resources attempting to investigate and develop a site that ultimately would be deemed unsuitable based on the geologic or hydrologic conditions. Site developers and industry professionals will have a clear understanding of the geologic or hydrologic conditions that would render a site unsuitable prior to initiating investigation activities at a site. The proposed rulemaking will clarify the conditions for site disapprovals and resolve inconsistencies so that all sites are evaluated and approved or disapproved on the basis of prescribed conditions set forth in the rules. Additionally, the less time an applicant has to spend on site characterization, the more cost effective it will be to develop a site. Sites with favorable geologic and hydrologic conditions will be developed more economically and faster than in the past.

It will also clarify which site conditions are considered geologically and hydrologically favorable and set forth characterization guidelines for sites located in those areas. This would potentially save a site developer money, time, and resources investigating and developing a site that has favorable geologic and hydrologic conditions. Additionally, sites that are developed in areas that are naturally protective of the environment and the public health could potentially reduce the long-term liability of the site for the developer. In the event of a contaminant release from a disposal facility, sites that are developed in favorable geologic environments would naturally have less of an impact on the environment and human health and safety. This would reduce the liability for a potential groundwater remediation program or natural resource damage restitution by the landfill owner.

5. The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenue.

Implementation of the rule would not require the increase of staff or associated resources. The rule will effectively further clarify and define rule language as it applies to siting criteria for proposed landfills. This will not require additional staff since the rule amendment will not alter the fundamental process the department uses to evaluate proposed landfill sites. Any enforcement of the rule would be a task assumed by the agency utilizing current staff and resources.

Furthermore, fewer activities required by the applicant could lead to an expedited permitting process. A potentially reduced permitting time-period would equate to less staff effort, less time, and fewer resource expenditures within the department.

6. A comparison of the probable costs and benefits of the proposed rule to the probable costs and benefits of inaction, which includes both economic and environmental costs and benefits.

Section 4 of this Report identifies several difficulties encountered when attempting to make a comparison between the likely costs and benefits of the proposed rule. This section further explains the difficulty found when making a comparison with the costs and benefits potentially associated with inaction.

Failure to act would not effect the rule as it currently exists. Section 260.205 RSMo requires the department to approve or disapprove a proposed site prior to issuance of a construction permit. However, the current rule does not clearly identify and define those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste disposal area. Agency professionals use professional experience, discretion, and scientific data and information to make a determination on the suitability of a proposed solid waste disposal area. The agency does this without clearly defined parameters outlined in the rule. This can lead to a perception that the agency is acting arbitrarily and capricious when evaluating proposed landfills and the perception that each proposed site is not considered on the same merits. This type of environment has in the past resulted in litigation against the agency from a site developer whom did not agree with the department's decision to disapprove a site. Litigation typically consumes an enormous amount of staff hours involving file research, interrogatories, depositions, administrative proceedings, and testimony.

If the proposed rulemaking does not become effective, it is possible that the department will be faced with administrative appeals, or will face legal suit, when a decision is made to deny a site based on geologic or hydrologic suitability. It may give the perception that the agency is acting arbitrarily and capricious when evaluating proposed landfills and the perception that each proposed site is not considered on the same merits. It is very difficult to make a determination of environmental costs and benefits without comparing the associated cost of lowered public health and long-term environmental damage. As discussed in section 4 of this Report, groundwater protection is crucial.

One of the state's most important and valuable resources is groundwater. This groundwater is contained in and migrates through bedrock or alluvial aquifers. In some areas of the state there are multiple aquifers present, however, in areas where groundwater resources are poor there may be only one usable aquifer or simply none at all. Protection of these groundwater resources means protection of domestic usage, commerce, industrial needs, power generation, and other components of society that is crucial to support a society. One overall economic benefit could be seen in good water quality. Water usage restrictions could severely impact many human activities including commercial development, industrial development, tourism, and overall health of the population.

Development of site suitability conditions will lead to solid waste disposal facilities being sited in areas that are suited toward natural protection of the public and the environment. In the event of a contaminant release from a disposal facility, sites that are developed in favorable geologic environments would pose less of a risk to environmental contamination and public health and safety.

The outcome of the proposed rulemaking should clarify the conditions for site approvals and disapprovals and resolve the perception of inconsistencies so that all sites are evaluated and approved or disapproved on the basis of prescribed conditions set forth in the rules. A goal is to make the decisions as transparent as possible.

7. A determination of whether there are less costly or less intrusive methods for achieving the proposed rule.

There could be other methods for achieving the same results of the proposed rulemaking. As discussed in section 8 of this Report, several alternative methods for achieving the purpose of the proposed rule were considered during the stakeholder process. However, these methods are not considered to be as cumulatively effective as the proposed rulemaking.

One option that has been used to successfully prohibit landfill development is the adoption of local restrictions. Municipal or County governments could enact laws or ordinances that would provide similar or greater protection within their districts. This has been done successfully in some communities. However, reliance on restrictions at a local level is not considered to provide the same degree of protection for the entire state, its citizens and resources. In addition, local ordinances and restrictions are often adopted and/or rescinded without input from the public. This type of method would not necessarily ensure that solid waste disposal facilities are sited in areas that are suited toward natural protection of the public and the environment. It would only preclude solid waste disposal facility development in areas where the local government has enacted an ordinance to address the matter.

It should be noted that many communities and individuals do not want landfills located in close proximity. Many citizens and communities consider landfills to be liabilities to environmental protection, public health and safety, property values and other economic factors. This rule does not preclude local governments from enacting

stricter landfill siting requirements, but it does afford the same level of protection to all citizens if there are not local ordinances in place to do so.

8. A description of any alternative method for achieving the purpose of the proposed rule that were seriously considered by the department and the reasons why they were rejected in favor of the proposed rule.

Several alternatives were initially considered. These alternatives were discussed during the stakeholder meetings. Ultimately, these alternatives were rejected for what is believed to be the most practical, sensible alternative.

One option discussed during the stakeholder process was the development of a list of unsuitable site characteristics. This option would create a list of specific geologic or hydrologic conditions that would be considered fatal physical flaws. Proposed landfill sites that were identified to have one of the conditions on the list would be disapproved for development. This alternative did not contain provisions for identifying proposed landfill sites in favorable geologic or hydrologic conditions and additionally appeared to be overly restrictive without allowing consideration of certain engineering applications. Although this alternative was considered, it was not selected as the most pragmatic approach.

Another option that was discussed was the development of a scoring mechanism that would assign a numerical factor to specific geologic or hydrologic conditions and then “rate” a proposed landfill site based on its overall numerical score. This type of rating mechanism has been successfully applied to and utilized for other rules and guidelines within the agency. Ideally, this alternative would give a low, or favorable score to proposed landfill sites that had favorable geologic or hydrologic conditions. Proposed landfill sites that were identified to have geologic or hydrologic conditions that are considered to render a site unsuitable would receive a high, or unfavorable score. This method would allow proposed landfill sites which have some adverse geologic or hydrologic conditions to be addressed through appropriate engineering analysis and demonstration. Although this method was considered a viable option, it was not chosen. It is believed that this option would have required significant fundamental changes to the current rule and necessitated the development of a complex numerical rating system.

A method of using a risk-based approach was also considered. This option would have essentially left much of the current rule in place with the addition of language that would require a risk-based analysis to demonstrate how unfavorable and adverse geologic or hydrologic conditions would impact human health or the environment from a risk standpoint. The risk-based analysis would be utilized to determine the risk to a particular receptor and if the calculated risk was within acceptable parameters, the proposed landfill would receive approval. This type of risk-based analysis has been successfully applied to and utilized for other rules and guidelines within the agency. Although this method was considered a viable option, it was not chosen. It is believed that this option would have required significant fundamental changes to the current rule and necessitated the development of a complicated risk-

based approach to landfill siting and development. Additionally, it is anticipated that department staff would not currently have the expertise in several areas of health science and risk analysis needed to make appropriate decisions.

9. An analysis of both short-term and long-term consequences of the proposed rule.

Section 4 and 5 of this Report discusses the economic and environmental costs and benefits of the proposed rule and the probable costs to the agency implementing the rule. Section 6 of this Report provides a comparison of the economic and environmental costs and benefits associated with the proposed rule to the probable costs and benefits of inaction. The reader should refer to those sections for specific information. This section of the Report offers further discussion and analysis of the consequences of the proposed rule.

Definitions

Several phrases and words in the proposed rule needed to be defined in order to clearly detail their meaning as it applies to the proposed rule. For consistency and ease of reference, these definitions have been added to **10 CSR 80-2.010**. The addition of these definitions does not constitute a change in the regulation, they increase the consistency in how the terms are used in implementing the rule.

Identification of geologic and hydrologic conditions that are not suitable for the development of a solid waste or demolition waste disposal area

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area. Specifically, the proposed language identifies and defines those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste or demolition waste disposal area. Proposed sites with these conditions would be denied by the department. The short-term consequences of the proposed rule will likely be negligible since the rule will not apply to existing facilities. The long-term consequences of the proposed rule will be much greater. It is anticipated the proposed rulemaking will be to reduce or eliminate the existing risks from siting solid waste disposal facilities in areas where the geologic or hydrologic conditions are poor. Thereby providing greater protection for groundwater resources and the public health and safety.

Identification of geologic and hydrologic conditions that are not suitable for the development of a utility waste disposal area

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed utility waste disposal area. Specifically, the proposed language identifies and defines those geologic and hydrologic conditions which render a site unsuitable for development of a utility waste disposal area. Proposed sites with these conditions would be denied by the department. As discussed in section 2 and **Appendix A** in this Report, by-products derived from the combustion of fossil fuels are relatively inert when compared to putrescent or demolition waste. These materials can be placed in areas where the geologic or hydrologic conditions would not be suitable for development of a solid waste or demolition waste disposal

area. The short-term consequences of the proposed rule will likely be negligible since the rule will not apply to existing facilities. The long-term consequences of the proposed rule will be much greater. The proposed rule should not negatively impact the future development and construction of power generation facilities or utility waste disposal sites. The geologic or hydrologic conditions outlined in the rule only prohibit development in areas where there is significant risk for catastrophic failure or an inability to effectively monitor landfill performance. It is anticipated the proposed rulemaking will be to reduce or eliminate the existing risks from utility waste disposal facilities in areas where specific geologic or hydrologic conditions are poor. Thereby providing greater protection for groundwater resources and the public health.

Insufficient data to allow a determination to be made about site suitability

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed utility waste disposal area. Specifically, the proposed language allows for the department to give preliminary approval to a site where the existing geologic and/or hydrologic data is insufficient to allow a proper determination of site suitability. This gives the department staff the ability to work with a site developer to conduct an extensive site investigation that fully characterizes the geologic and hydrologic conditions of the proposed site and demonstrates that the site is suitable for the development of a solid waste disposal facility. The short-term consequences of the proposed rule will likely be negligible since the rule will not apply to existing facilities. The long-term consequences of the proposed rule will be positive for the applicant, the public, and the department. It will allow the department the ability to give preliminary site approval of a proposed landfill without compromising the ability to disapprove a site if those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste disposal area are identified during a comprehensive site characterization effort. Following characterization, proposed sites with any conditions identified in **10 CSR 80-2.015(1)(A)** would be denied by the department.

Geologic and hydrologic conditions that are well-suited for the development of a solid waste disposal area

Language has been added to **10 CSR 80-2.015(1)(A)** in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed utility waste disposal area. Specifically, the proposed language defines solid waste disposal area siting criteria that would apply to sites proposed in areas of optimum geologic and hydrologic suitability. Proposed landfill sites that have criteria set forth in this portion of the rule would be subject to less stringent site characterization requirements. This should lead to a more concise site characterization process and potentially reduce the necessary timeframe required to receive a construction permit. This would potentially save an applicant money, time, and resources investigating and developing a site that is known to have favorable geologic and hydrologic conditions.

It is also believed that this portion of the rule will encourage developers to select proposed solid waste disposal sites in areas where the natural site conditions are protective for long-term performance of the landfill. Additionally, sites that are

developed in areas that are naturally protective of the environment and the public health could potentially reduce the long-term liability of the site for the developer. In the event of a contaminant release from a disposal facility might occur, the public would be protected and it would have less impact on the environment.

The short-term consequences of the proposed rule will likely be negligible since the rule will not apply to existing facilities. The long-term consequences of the proposed rule will be positive. It is anticipated the proposed rulemaking will be to reduce or eliminate the existing risks from siting solid waste disposal facilities in areas where the geologic or hydrologic conditions are poor.

Approval or disapproval of the detailed site investigation and characterization report
Language has been added to **10 CSR 80-2.015(2)** in an effort to provide further clarification of the decision-making process on the suitability of a site conditions and ultimately a proposed solid waste disposal area. Specifically, the proposed language identifies under which circumstances a site will be approved or disapproved for development of a solid waste disposal area following a site investigation and characterization. Therefore, the short- and long-term consequence of the proposed language is to provide further clarification and promote a more consistent and transparent understanding of the rule.

Appendix 1, Guidance for Conducting and Reporting Detailed Geologic and Hydrologic Investigations at a Proposed Solid Waste Disposal Area

This document is incorporated into the current rule and is written to provide a site developer with detailed explanation of the basic elements and format for conducting a detailed site investigation. The document sets forth minimum requirements for the site investigation activities and provides guidance on the acceptable presentation of the subsequent data. Several changes were required to the language in the document to make it consistent with the language proposed in the rulemaking. The modifications or additions of language in the document do not constitute a change in the regulation, they increase the consistency in how the terms are used in implementing the rule.

Therefore the short- and long-term consequences of this proposed change to the rule are that they create an easier and more direct guidance of the applicability of the proposed rulemaking to the site investigation process. This should increase the understanding and efficiency when a developer is proposing a site characterization workplan.

10. An explanation of the risks to human health, public welfare or the environment addressed by the proposed rule.

This rulemaking is an effort to clarify and simplify the process of a preliminary site evaluation and decision making on the suitability of a proposed solid waste disposal area. In part, the proposed rule attempts to identify and clearly define those geologic and hydrologic conditions which render a site unsuitable for development of a solid waste disposal area.

Without clarification of favorable and unfavorable geologic criteria, it will be more difficult for the applicant and the department to locate landfills in suitable settings. If a landfill is located where poor geologic or hydrologic conditions exist, it could potentially lead to a local or regional water source becoming impacted by contaminants from a landfill. These costs associated with this scenario could include requiring water treatment systems on individual domestic wells, the providing a potable water supply to affected citizens, or the potential cost of new wells should a current aquifer or water source for a municipality be impacted.

One of the state's most important and valuable resources is groundwater. This groundwater is contained in and migrates through bedrock or alluvial aquifers. In some areas of the state there are multiple aquifers present, however, in areas where groundwater resources are poor there may be only one usable aquifer or simply none at all. Protection of these groundwater resources means protection of domestic usage, commerce, industrial needs, power generation, and other components of society that is crucial to support a society. One overall economic benefit could be seen in good water quality. Water usage restrictions could severely impact many human activities including commercial development, industrial development, tourism, and overall health of the population.

11. The identification of the sources of scientific information used in evaluating the risk and a summary of such information.

Background research was conducted to identify the methods and practices other states were using to guide solid waste disposal development. This information was used to initially guide the discussion of the stakeholder and rulemaking process. As the stakeholder meetings progressed, a framework of proposed rulemaking was determined. Subsequently, research into the scientific data that supported the rule language was conducted. A list of the technical information utilized for the rulemaking includes: independent technical scientific data, scientific data from the solid waste industry, professional scientific papers, and rule language from other states. A list of the information used to develop the rule, including technical documents and data, as well as a discussion on how this information was used, is found in section 2 of this Report and is included as **Appendix A**.

12. A description and impact statement of any uncertainties and assumptions made in conducting the analysis on the resulting risk estimate.

During the initial portion of the stakeholder process, the department conducted a survey of the stakeholders to determine the fundamental assumptions that should be used to guide the proposed rulemaking process. Survey responses were analyzed and discussed to determine the stakeholders desire to consider specific issues. Additionally, survey responses were also discussed in order to determine the stakeholders' fundamental assumptions regarding landfill siting criteria and site suitability. Stakeholders were also encouraged to provide additional criteria not found in the survey questions and provide comments on the survey questions and their content. The outcome of this exercise produced several assumptions related to landfill siting that were used to guide discussion among the stakeholders and provided

a framework for the proposed rule. The major assumptions are summarized and include:

- Missourians expect landfills to be sited safely and believe that long term risks to human health, safety, and the environment should be considered in locating landfills;
- The rule should clarify which geologic and hydrologic conditions are considered suitable for siting landfills and which are not;
- The life of a landfill extends beyond the regulatory time frame and long-term maintenance and remediation at landfills should be minimized;
- Drinking water supplies should be protected from impacts associated with landfills;
- Landfills should be sited where contaminant releases can be detected;
- Migration of landfill gas should not pose a public health or safety risk;
- Areas of karst development and areas over active faults are not appropriate conditions for landfill development;
- Site-specific data should be considered when evaluating landfill sites;
- Depth to groundwater with respect to the base of the landfill should be considered when establishing landfill siting criteria;
- The potential use of an aquifer and the natural quality of groundwater should be considered when establishing landfill siting criteria;
- The distance to losing streams, caves, or springs should be considered when establishing landfill siting criteria;
- The permeability of bedrock or surficial materials should be considered when establishing landfill siting criteria;
- Presence of any solution features or voids should be considered when establishing landfill siting criteria;
- The presence of a natural barrier to water and/or gas migration should be considered when establishing landfill siting criteria;
- The presence of geologic hazards and underground mining should be considered when establishing landfill siting criteria;
- Groundwater flow direction should be considered when establishing landfill siting criteria.

In summary, the results of the stakeholder survey indicated that there was a strong desire to site landfills in areas that are protective of public health and safety and in areas that provide protection of important natural resources. The survey results also suggested that there was strong support for establishing landfill siting criteria in the rule. These assumptions were utilized to frame the proposed rulemaking in an effort to simplify the process of a preliminary site investigation and clarify the decision-making process on the suitability of a proposed solid waste disposal area.

13. A description of any significant countervailing risks that may be caused by the proposed rule.

Countervailing risks are unknown.

14. The identification of at least one, if any, alternative regulatory approaches that will produce comparable human health, public welfare or environmental outcomes.

Alternative approaches considered during the rulemaking are discussed in section 8 of Report. Other alternatives could be identified following during the public comment period on the proposed rule. As previously discussed in this Report, the proposed rulemaking is an effort to clarify and simplify the process of a preliminary site evaluation and decision making on the suitability of a proposed solid waste disposal area. The department has made every effort to ensure that the proposed rule is the most practical and provides the best level of protection to public health and the environment while enabling Missourians to safely and economically dispose of solid waste in our state.

15. Provide information on how to provide comments on the Regulatory Impact Report during the 60-day period before the proposed rule is filed with the Secretary of State.

The department will post a notice in the (undetermined newspaper) that the Regulatory Impact Report is available for public comment for a period of 60 days. The same notice will be posted on the department's web page at <http://www.dnr.mo.gov/geology/geosrv/geo-rules-in-dev.htm>. Persons wanting to comment on the Report are asked to submit them in writing to Joe Gillman, Geological Survey Program Director, PO Box 250, Rolla, Missouri, 65402, or joe.gillman@dnr.mo.gov. Comments will be accepted for 60 days after the Report is posted.

16. Provide information on how to request a copy of comments or the web information where the comments will be located.

Requests for copies of the comments received on this Report may be sent to Joe Gillman, Geological Survey Program Director, PO Box 250, Rolla, Missouri, 65402, or joe.gillman@dnr.mo.gov. Comments on the report will be posted on the department's web page at <http://www.dnr.mo.gov/geology/geosrv/geo-rules-in-dev.htm>.

Appendix A

Technical Documents and Data Used in Developing Proposed Rule

A. Peer-Reviewed Publications

1. Allen, A. "Containment Landfills: The myth of sustainability." Engineering Geology 60 (2001): 4-19.
2. Arigala, Sumadha G., Theodore T. Tsotsis, Ian A. Webster, Yanis C. Yortsos, and James J. Kattapuram. "Gas Generation, Transport, and Extraction in Landfills." Journal of Environmental Engineering, v.121 (1995): 33-44.
3. Challa, Jay, Dale Skoff, and Frank J. Quirus. "Landfill gas a source of VOC's in groundwater." Journal of Geotechnical and Geoenvironmental Engineering, v.1 (1997): 61-75.
4. Domenico, Partick A., and Franklin W. Schwartz. Physical and Chemical Hydrogeology. 1st ed. New York, New York: John Wiley and Sons, 1990. 1-824.
5. Driscoll, Fletcher G., Groundwater and Wells. 3rd ed. St. Paul, Minnesota: Johnson Filtration Systems, Inc., 1986. 1-1089.
6. Duley, James W., ed. A geological approach to groundwater protection in the soluble rock lands of Missouri. Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 6 Apr. 1997, P.E. LaMoreaux and Associates, Inc. Rotterdam: Balkema, 1997.
7. Ewers, Ralph O., Keith A. White, Kurt Paschl, and Mark B. Hanish. Shallow groundwater and DNAPL movement within slightly dipping limestone, southwestern Kentucky. Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 24 Sept. 2005, P.E. Lamoreaux and Associates, Inc. American Society of Civil Engineers, 2005.
8. Freeze, Allan R., and John A. Cherry. Groundwater. 1st ed. Englewood Cliffs, New Jersey: 1979. 1-604.
9. Horace, Moo-Young, Johnson B, Johnson A, Carson D, Lew C, Liu S, and Hancock K. "Characterization of Infiltration Rates from Landfills: Supporting Groundwater Monitoring Efforts." Environmental Monitoring and Assessment, v.96 (2004): 283-311.
10. House, Jo K. Carbonate rock investigation guidance policy for siting landfills in karst areas of Tennessee. Fifth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 2 Apr. 1995, P.E LaMoreaux and Associates, Inc. Rotterdam: Balkema, 1995.

11. James, Murray P., Rouse V. Jim, and Carpenter B. Alden. "Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications." Water Research, v.15 (1981): 745-757.
12. Memon, Bashir A., Abner F. Patton, Lois D. George, and Thomas S. Green. Site selection and design considerations for construction in karst terrain/sinkhole prone areas. Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 10 Apr. 1999, P.E. Lamoreaux and Associates, Inc. Rotterdam: Balkema, 1999.
13. Nastev, Miroslav, Rene Therrien, Rene Lefebvre, and Pierre Gelinas. "Gas production and migration in landfills and geologic materials." Journal of Contaminate Hydrology, v.52 (2001): 187-211.
14. Shiou-San, Kuo, Karishma Desai, and Lymari Riveria. "Design methods for municipal solid waste landfill liner system subjected to sinkhole cavity under landfill site." Journal of Geotechnical and Geoenvironmental Engineering, v.9 (2005): 281-291.
15. Wanfang, Zhou, Barry F. Beck, and Ramona C. Josefczyk. "Disposal of Waste in Sinkholes: Hydrological Significance, Environmental Implications, and Appropriate Application of Dye Tracing." The Professional Geologist, v.42 (2005): 46-51.
16. White, William B. Geomorphology and Hydrology of Karst Terrains. New York: Oxford UP, 1988. 1-464.
17. Yang, Michael Z., and Eric C. Drumm. Stability evaluation for the siting of municipal landfills in karst. Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, 10 Apr. 1999. Rotterdam: Balkema, 1999.

B. Non-Peer Reviewed Publications

1. "Assessment of Leaching Risk to the Environment from the Use of Pulverised Fuel Ash (PFA)." United Kingdom Quality Ash Association. Jan. 2003. United Kingdom Quality Ash Association. Jan. 2006 <http://www.ukqaa.org.uk/>
2. "AMEREN - Waste Management Fact Sheet." AmerenUE Corporate Homepage. 2006. Ameren UE. Jan. 2006 http://www.ameren.com/ENVIRONMENT/ADC_EV_WasteManagement.pdf
3. City of Cheyenne, Wyoming. Landfill Advisory Committee. City of Cheyenne. Summary Description of Exclusionary Criteria. Cheyenne, Wyoming: City of Cheyenne, 2004 http://www.cheyennecity.org/exclusionary_criteria.htm

4. "Coal Combustion Byproducts (CCB's)." The Fly Ash Resource Center. July 2005. Fly Ash Resource Center. Jan. 2006 <http://www.rmajko.com/flyash.html>
5. "Environmental Fact Sheet - Regulatory Determination for Waste from the Combustion of Fossil Fuels." Washington DC: United States Environmental Protection Agency, 2000 <http://www.epa.gov/epaoswer/non-hw/muncpl/fossilfuel.htm>
6. Evangelou, V.p., and James K. Neathely. "Bituminous Fly Ash Release potential Modeling and Remediation for Arsenic, Boron, and Heavy Metals." Kentucky Water Resource Research Institute. Nov. 1995. University of Kentucky. Jan. 2006 <http://www.uky.edu/waterresources/uk-res08.html>
7. "Fact Sheet #2 - Investigation of Environmental Contamination at the Cobb's Quarry Landfill in Beaverton." Portland: Oregon Department of Environmental Quality, 2001 <http://www.deq.state.or.us/nwr>
8. "Fly Ash Concrete - Inexpensive Replacement for Portland Cement." PATH - Partnership for Advancing Technology in Housing. Jan. 2005. PATH - Partnership for Advancing Technology in Housing. Jan. 2006 <http://www.toolbase.org/techinv/techdetails.aspx?technologyid=217>
9. "Ground Water Use for America." National Groundwater Association. 2005. 19 Jan. 2006 <http://ngwa.org/public/fgwusage.html>
10. Hatheway, Allen A. Environmental Geological Engineering - Application of Engineering Geological, Geotechnical and Hydrological Methods to Solution of Environmental Protection Issues. Rolla, Missouri: University of Missouri-Rolla, 1983. 1.
11. Kahlon, Livleen. "Air Pollution - Flyash." EDUGREEN - environmental learning for the young. Jan. 2006. The Energy Resource Institute. Jan. 2006 <http://edugreen.teri.res.in/explore/air/flyash.htm>
12. Miller, Don E., and James E. Vandike. Missouri State Water Plan Series Volume II, Groundwater Resources of Missouri. Vol. II. Rolla, Missouri: Missouri Department of Natural Resources, 1997. 1-210. <http://www.dnr.mo.gov/env/wrc/statewaterplanPhase1.htm#GWRM>
13. "National Priorities List - Woodlawn Landfill, Woodlawn, Maryland." EPA National Priorities List. June-July 2004. Environmental Protection Agency. 1 Jan. 2006 <http://epa.gov/reg3hwmd/super/sites/MDD980504344/index.htm>
14. "Sanitary Landfilling as Part of Integrated Solid Waste Management." Solid Waste Association of North America - Technical Policies. 2003. Solid Waste Association of North America - SWANA. Jan. 2006 http://www.swana.org/sections/educate/tec_techpolicies.aspx

15. "Typical Chemistry in Coal Fly Ash in Weight Percent (wt%)." The Fly Ash Resource Center. Jan. 2005. Fly Ash Resource Center. Jan. 2006
<http://www.rmajko.com/chemistry.htm>

The department used these reports and information as a supplement to the peer-reviewed information. These reports are typically written by industry professionals and contain information that was important to correctly guide the understanding of how the proposed rulemaking could be effective and still consider government and industry concerns.

C. Raw Data

1. Associated Electric Cooperative, Inc., Springfield, Missouri, Data from Fly Ash Test Results for parts of: 2004, 2005.
2. Aquila, Kansas City, Missouri, Data from Fly Ash Test Results for part of 2005.
3. Brady Wilson, Director, Solid Waste Department, City of Rolla Missouri, personal communication, 2006.
4. Census of Missouri Public Water Systems 2005. Missouri Department of Natural Resources. Jefferson City, Missouri: Missouri Department of Natural Resources, 2005. 1-354.
5. City Utilities, Springfield, Missouri, Data from Fly Ash Test Results for parts of: 1991, 1992, 1993, 2001, 2005.
6. Hutson, Susan S., Nancy L. Barber, Joan F. Kenny, Kirsten S. Linsey, Deborah S. Lumia, and Molly A. Maupin. United States Geological Survey Circular 1268 - Estimated use of water in the United States in 2000. United States Geological Survey circular 1268. Denver, Colorado: United States Geological Survey, 2004.
<http://mo.usgs.gov/epa/nh/>
7. Kansas City Power and Light, Kansas City, Missouri, Data from Fly Ash Test Results for part of 2004.

Raw data were analyzed to gain a better understanding of several important factors in the rulemaking. These data were used to estimate the usage amounts and value of groundwater in Missouri. These data were also analyzed to detect any historic trends of the characteristics of coal combustion by products and to determine current practices in the solid waste disposal industry. This data was not used to establish criteria for the rulemaking. It was used for informational purposes.

D. State Regulations

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